

## Effect of *Banana bract mosaic virus* (BBrMV) on growth and yield of cultivar Nendran (Plantain, AAB)

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**ABSTRACT:** To find the yield loss due to BBrMV in cv. Nendran (AAB), fixed field plot experiments were conducted in Tiruchirapalli District of Tamil Nadu during 1997-1999. BBrMV infected plants and symptom free healthy plants were randomly selected and tagged for recording the observations. The average yield reduction due to BBrMV was 30 per cent. The reduction in bunch weight over healthy plants was 32.7, 53.69, 30.61 and 28.84 per cent in four different fields and the variations in bunch weights of infected and healthy plants were highly significant. The yield loss varied between orchards. The yield differences between healthy and infected plants were more in fertile soil than in saline sodic, low fertile soil and from the infected plants malformed bunches of less weight, underdeveloped fingers emerged, making them not marketable.

**Key words:** *Bract mosaic virus*, plantain, banana, soil fertility, yield loss

Banana and plantain are the most important fruit crops of our country. Fungal and viral diseases considerably hamper banana production in India. Banana Bract Mosaic Virus (BBrMV) disease was first observed in the Phillipines in 1988 (Magnaye and Espino, 1990) and yield loss to the tune of 40 per cent has been recorded (Roperos and Magnaye, 1991). In India, banana bract mosaic is present in Tamil Nadu, Kerala, Karnataka and Andhra Pradesh (Rodoni *et al.*, 1997, Thomas *et al.*, 1997, Selvarajan *et al.*, 1997, Thangavelu *et al.*, 2000, Singh, 2002, Anita Cherian *et al.*, 2002, Kiranmai *et al.*, 2005). The disease is characterized by spindle shaped streaks and stripes on the pseudostem and mosaic pattern on the bracts. In severe stage of infection, the leaves displayed distinct discontinuous streaks along the primary veins, which appear to be irregularly thickened or raised. Scattered white to yellowish streaks across from the midrib to the margin of the leaf were observed. The key identifying symptoms of the disease are unusual reddish brown or necrotic discontinuous streaks towards the base of the pseudostem. Aphids, *Rhopalosiphum maidis* and *Aphis gossypii* transmit BBrMV in a non-persistent manner (Magnaye and Espino, 1990). Banana aphid *Pentalonia nigronervosa* and cowpea

aphid *Aphis craccivora* also transmit the virus (Selvarajan *et al.*, 2006). The virus particles are 750nm long flexuous filaments (Singh *et al.*, 2000).

Banana bract mosaic disease (BBrMD) is recently described virus disease of banana. The incidence of disease ranges from 5 to 36 per cent and more in cv. Nendran in Kerala. The infected plants flowers, but produce very small bunches with curved brittle fruits. Very severely affected plants may fail to flower and may die by stunted growth and necrosis of pseudostem. The male buds are dark purple in colour with mosaic patches. There are varietal differences in the symptomatology of the disease. BBrMV has been reported to cause considerable damage in Cavendish banana plantations. The disease has a great impact on the yield of the crop with maximum yield reduction in cv. Robusta (AAA) (70%), followed by cv. Nendran (AAB) (52%) (Anita Cherian *et al.*, 2002). The accessions with ABB genome have maximum incidence of the disease. Besides yield reduction, the fingers become malformed and curved, which reduce the market acceptability of fruits (Anita Cherian *et al.*, 2002).

The present survey and investigation was undertaken to study the different types of symptoms

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due to BBrMV infection, grouping the symptoms into different categories and to assess the yield reduction in such categories compared to healthy plants in cv. Nendran. It was also aimed to find out the yield loss due to BBrMV under different soil fertility levels.

## MATERIALS AND METHODS

Fixed plot experiments were conducted at Tiruchirapalli, Tamil Nadu, India during 1997-99, to evaluate the effect of BBrMV on growth and yield in cv. Nendran. Recommended wetland banana cultivation practices were followed in the fixed experimental plots. Tiruchirapalli is located at 11.50°N latitude and 74.50°E longitude and the altitude is 90m above mean sea level. The annual average maximum temperature, minimum temperature, relative humidity and the annual rainfall were 34°C, 23.2°C, 65.9 % and 557 mm respectively in 1997-98, and 34.29°C, 23.78°C, 64.53 %, 538 mm respectively in 1998-1999.

### **Symptomatology of BBrMV and yield loss:**

Among Nendran banana cultivated fields in Tiruchirapalli district, a BBrMV infected field was selected randomly during the year 1997-98. The field had 2000 plants spaced at 1.8 m x 1.8m. Observations recorded for 2000 plants on symptoms. Besides recording the BBrMV common symptoms, i.e., reddish to pinkish streaks on pseudostem, spindle shaped mosaic pattern on leaves, mosaic on fingers and bracts, other symptoms associated with disease were also recorded, grouped into three categories of symptoms and the per cent severity categories



**Plate 1.** BBrMV affected banana plant exhibits traveler palm leaf arrangement

occurred in the orchard was worked out. The presence of virus in symptomatic plants was tested by DAC-ELISA using BBrMV polyclonal antiserum (provided by J.E.Thomas, QDPI, and Australia) as per Clark and Bar-Joseph (1984). The parameters like bunch weight, total number of hands, average number of fingers, finger length, width and aphid population per plant were recorded for healthy and the three disease categories of BBrMV infected plants. Four treatments, i.e., 3 infection categories viz., i) plants with poor vegetative growth and bearing bunch with under developed fingers; ii) plants exhibiting traveler palm leaf arrangement and / or bearing poor bunch with extremely short or long peduncle and iii) lean, lanky unusually tall plants bearing small underdeveloped bunches and a healthy, ten replications and three plants per replication were used for analysis.

**Assessing the yield loss under different soil fertility status:** As Nendran banana is grown as an annual crop; another fixed plot experiment was



**Plate 2.** Infected plant bearing poor bunch with extremely short peduncle

conducted in subsequent year (1998-99). Four different fields having different soil status were randomly selected in Tiruchirapalli district. The soil pH, EC, OC, N, P, K, Ca, Mg and Na for the selected fields were analyzed as per methods described by Tandon (1995). Hundred plants each of healthy and BBrMV infected plants were selected randomly in the fields and they were tagged individually. The growth and yield parameters like leaf area, girth, height, number of hands per bunch and bunch weight were recorded from each field. Two-factor randomized block design was adopted for this field trial. The data collected were analyzed statistically.

## RESULTS AND DISCUSSION

Out of 2000 plants observed, 44 per cent plants exhibited symptoms of BBrMV in the month of November (before bunch emergence) and the incidence of banana aphid *Pentalonia nigronervosa* was also high. Symptomatic plants were tested for BBrMV in DAC-ELISA and confirmed as positive and the glass house grown healthy plants were negative (data not shown). After bunch emergence, the BBrMV incidence rose to 58.1 % in December and at the end of January 1998 the incidence reached to about 60%. In some of the plants, the suckers had BBrMV symptoms but not the main plant. The per cent disease incidence increased from 44 to 60, probably due to presence of banana

aphid in the orchard. Selvarajan *et al.* (2006) reported that the banana aphid *Pentalonia nigronervosa* transmits BBrMV in a non-persistent manner. The other possibility is that the plants would have expressed the symptoms in later stage i.e. after a certain time of latent period. Aphid populations were significantly more on infected plants than that on healthy plants. Different types of symptoms due to BBrMV were noticed in the experimental orchard. Besides typical BBrMV symptoms (pinkish streaks on pseudostem, spindle shaped mosaic on leaves, mosaic on fingers and bract), infected plants had expressed different types of symptoms and they were grouped into three categories (Table 1). Around 6.95 per cent infected plants exhibited rotting of heartleaf and no bunch emergence. The yield parameters for three infected categories and healthy were taken at the time of harvest and are furnished in the Table 1. Bunch weight, total number of hands, finger length and width of healthy plants were significantly different from the 3 categories of BBrMV infected plants. Bunch weight in healthy plants was 15.15 kg where as the infected plants gave 1.08, 2.25, and 4.39 kg from infected categories 1, 2 and 3 respectively. Some of the infected plants threw bunches of 1.0 to 2.25 kg in weight, malformed, underdeveloped fingers, making them not marketable. Hence, the economic loss could be considered as cent percent. The reduced bunch weight in BBrMV plants are due to undeveloped fingers. The results are in

**Table 1.** Effect of BBrMV on yield parameters in cv. Nendran and average aphid population per plant

Treatments	Description of symptoms severity in infected categories* and healthy plants	Bunch weight (kg)	Total hands	Average fingers	Finger length (cm)	Finger girth (cm)	Aphid population
Infected category -1	Plants with poor vegetative growth and bearing aborted bunch with ill developed fingers	1.08	4.6	8.7	9.9	7.3	25.6
Infected category-2	Plants exhibiting traveler palm leaf arrangement and / or bearing poor bunch with extremely short or long peduncle.	2.25	4.3	8.3	14.9	11.5	25.2
Infected category-3	Lean, lanky, unusually tall plants bearing small underdeveloped bunches.	4.39	5.1	9.8	18.6	12.8	16.4
Healthy	Uninfected healthy plants with no viral symptoms	15.15	6.6	11.8	27.7	17.6	11.4
CD at 5%		0.7	0.99	1.24	1.86	1.5	3.17

\* Infected plants exhibited the common BBrMV symptoms in addition to symptoms given in column 2

**Table 2.** Effect of BBrMV on growth and yield parameters in cv. Nendran grown in fields having different soil fertility

Name of the location of the fixed fields	Height (cm)			Leaf area (cm <sup>2</sup> )			Girth (cm)			No. of hands/bunch			Bunch weight (kg)		
	I	H	Mean	I	H	Mean	I	H	Mean	I	H	Mean	I	H	Mean
Allithurai (L1)	256.3	286.9	271.6	7711	10024	8867.2	56.2	58.2	57.2	6.25	5.73	5.73	4.96	7.37	6.16
Nachikuruchi (L2)	249.7	299.4	274.5	8949	10226	9587.3	55.1	62.9	59.1	5.5	5.85	5.68	5.08	10.97	8.02
Vayalur (L3)	250.5	259.2	254.8	7472	7991	7731.4	54.1	52.8	53.5	5.45	5.95	5.7	4.85	6.99	5.92
Thayanur (L4)	247.8	264.4	256.1	6831	8337	7583.7	51.5	54.8	52.2	5.5	5.95	5.73	4.69	7.70	4.68
Mean	251.1	277.5	-	7741	9144	-	54.3	57.2	-	5.41	6.00	-	4.69	7.70	-
C.D. (5%)															
Main treatments		16.03		644.7			3.51			NS			0.54		
Sub treatments		11.33		455.83			2.48			0.24			0.38		
Interaction		22.66		911.67			4.96			0.47			1.00		

I: Infected plants; H: Healthy plants

confirmation with the findings of Anita Cherian *et al.* (2002) that maximum yield reduction was recorded in Robusta (70%), followed by Nendran (52%) due to BBrMV infection in Kerala. Besides yield reduction, the fingers become malformed and curved reducing the market acceptability of fruits (Anita Cherian *et al.*, 2002).

The yield loss assessment in cv. Nendran due to BBrMV infection in four orchards (L1, L2, L3 and L4) are presented in table 2. The leaf area was significantly lower in infected plants when compared to healthy plants in each location. The reduction in leaf area was 23.07, 12.48, 6.49 and 18.06 per cent over healthy plants in orchards L1, L2, L3 and L4 respectively. However, except in L1, there is no significant difference in pseudostem girth among diseased plants. Significant difference in the height of both diseased and healthy plants was recorded in all the four locations. Nevertheless, there was no significant difference in the number of hands/bunch among diseased plants in all the locations. The bunch weight was reduced significantly in diseased plants when compared to that of healthy plants in all the fields. The reductions in bunch weight over healthy plants were 32.7, 53.69, 30.61 and 28.84 per cent in locations L1, L2, L3 and L4 respectively. In Tamil Nadu, the percentage incidence of BBrMV in Nendran (AAB), Poovan (AAB), Robusta (AAA), Red Banana (AAA), Ney Poovan (AB), Monthan (ABB) and Pisang Awak (ABB) were 15.93, 28.23, 4.57, 56.80, 5.31, 36.12 and 0.5 respectively (Selvarajan and Singh, 1997). The result revealed that the overall reduction in bunch weight in infected plants over healthy plants was 30 per cent. Roperos and Magnaye (1991) reported that BBrMV caused a yield loss of up to 40 per cent in Phillipines. Yield loss of up to 40 per cent in highly susceptible cvs. Saba, Cardaba (Espino *et al.*, 1990) and Lakatan (AAA) (Kenyon *et al.*, 1996; Thomas and Magnaye, 1996) has also been recorded. The failure of the fruit to fill on infected plants has been noted in India (Diekmann and Putter, 1996). The yield loss due to BBrMV varies from place to place depending on the soil fertility status. Assessing the yield loss due to viruses should be done at different climatic conditions and also the soil types to extrapolate the yield losses more precisely at state and national level.

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